Small Business Innovation Research/Small Business Tech Transfer

Integrated Silicon Carbide Electronics for Venus Surface Actuation, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

NASA has demonstrated a resolve for a flagship mission in the coming years to revisit Venus and land instruments on the surface. Venus has a corrosive, high-pressure (~100 bar), high-temperature (470°C) environment. A motor drive is the major theme that runs through the most critical needs for optimum geological and atmospheric exploration on Venus.

An electronically-controlled motor, operating at 470°C/100 bar, is the single most significant demonstration of the ability to perform robotic Venus surface exploration and the ultimate objective of the project.

Objectives

The ultimate outcome will be the first integrated motor drive subsystem suitable for the Venus surface.

The project will combine Honeybee Robotics' DC motors with the JFET-R silicon carbide (SiC) technology developed by the NASA Glenn Research Center. Ozark IC's high-temperature process design kit (PDK) for the JFET-R technology will be used to design an integrated stepper motor driver that can be serially controlled. Proof of concept will be demonstrated through prototyping, utilizing circuits designed by Ozark IC and fabricated by NASA Glenn. System performance will be estimated through high-fidelity simulation. The motor technology, packaging approach and SiC devices have been previously demonstrated to be operable at Venus surface temperatures, so combining these technologies is the next natural step in enabling actuation in these harsh environmental conditions.

The Objectives of Phase I are to Determine:

1. What is the ideal device topology for the motor drive and what voltage/current range can be achieved?
2. What chipset configuration and packaging technologies minimize system power and mass?
3. What performance can be expected from the proposed integrated motor + control module and how can it be used?

Anticipated Benefits

NASA has demonstrated a resolve for a flagship mission in the coming years to revisit Venus and land instruments on the surface. Venus has a corrosive, high-pressure (~100 bar), high-temperature (up to 500°C) environment. The proposed motor control electronic system is the next logical development step towards an enhanced mobility, actuation and manipulation capability on the Venus surface.

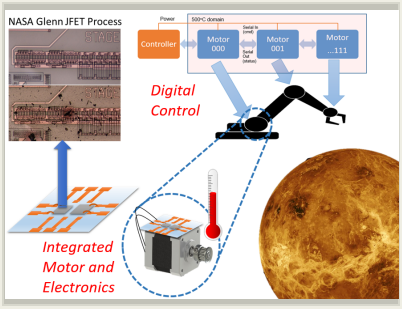

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Table of Contents

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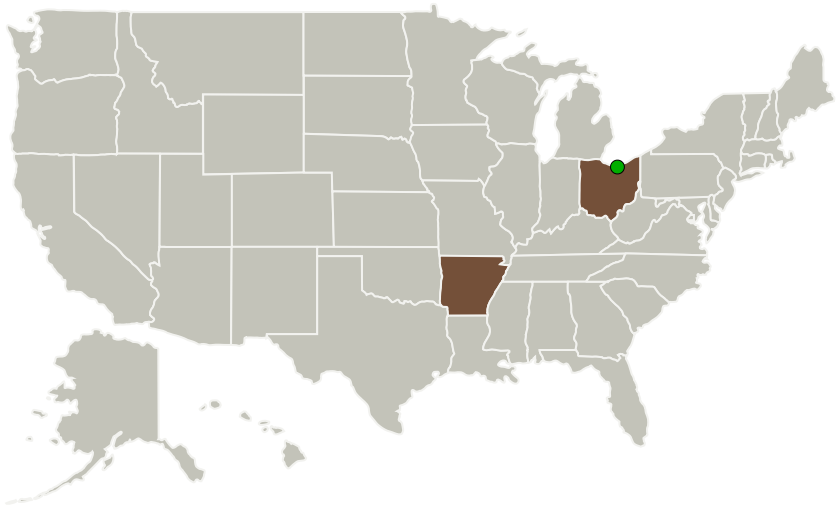
Obviously, any application that needs a very high temperature motor or actuator is a potential market.

- Geothermal/oil exploration – optimize drilling efficiency
- Jet engines – replace hydraulic controls
- Other markets include scientific explorations (volcanos), industrial (ovens) etc.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ozark Integrated Circuits, Inc.	Lead Organization	Industry	Fayetteville, Arkansas
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Arkansas	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ozark Integrated Circuits, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

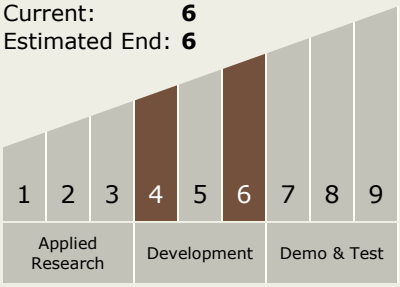
Carlos Torrez

Principal Investigator:

Anthony M Francis

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Project Transitions

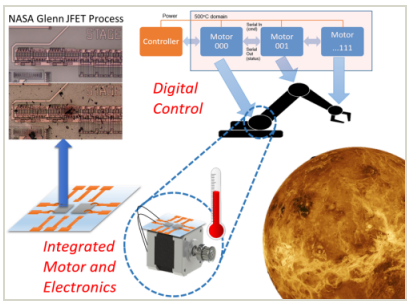
July 2018: Project Start

February 2019: Closed out

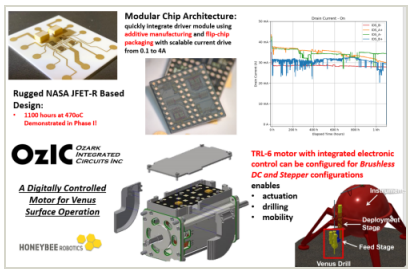
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141127)*

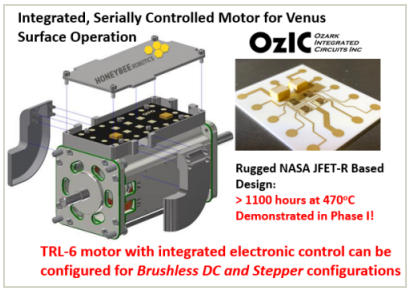
Images



Briefing Chart Image
Integrated Silicon Carbide Electronics for Venus Surface Actuation, Phase I
(https://techport.nasa.gov/image/135765)



Final Summary Chart Image
Integrated Silicon Carbide Electronics for Venus Surface Actuation, Phase I
(https://techport.nasa.gov/image/128364)



Final Summary Chart Image
Integrated Silicon Carbide Electronics for Venus Surface Actuation, Phase I
(https://techport.nasa.gov/image/132782)

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.3 Manipulation
    - TX04.3.4 Sample Acquisition and Handling

Target Destination

Others Inside the Solar System